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Claims

[c1] A process of forming an end of a tube having at least one internal surface feature on an internal circumference of the tube and projecting into an internal passage defined by the tube, the process comprising the steps of:
forcing an external die over the end of the tube and simultaneously inserting a mandrel through the internal passage within the end of the tube, the external die reducing the outer diameter of the end of the tube so as to define a reduced-diameter portion at the end of the tube, the mandrel being positioned farther into the internal passage than the reduced-diameter portion of the tube; and then
while the end of the tube remains within the external die, withdrawing the mandrel from the internal passage and through the reduced-diameter portion of the tube to eliminate at least a portion of the internal surface feature.

[c2] The process according to claim 1, wherein the portion of the internal surface feature is eliminated by deformation without physically removing from the tube the material defining the internal surface feature.

[c3] The process according to claim 1, wherein the external die and the mandrel are components of a tool assembly, the tool assembly further comprising a holder having a bore in which the external die is reciprocable in an axial direction of the bore, the mandrel being mounted within the tool assembly so as to be reciprocable relative to the external die.

[c4] The process according to claim 3, wherein the mandrel is attached to the holder so as not to be reciprocable relative to the holder.

[c5] The process according to claim 4, wherein the mandrel is reciprocably received in a bore defined by the external die.

[c6] The process according to claim 1, wherein the external die comprises a chamfer against which reduction of the end of the tube occurs during the forcing step, and the mandrel is circumscribed by the chamfer during the step of forcing the external die over the end of the tube.

[c7] The process according to claim 1, wherein the mandrel does not interfere with the at least one internal surface feature within the end of the tube during the step of forcing the external die over the end of the tube.

[c8] The process according to claim 1, wherein the end of the tube remains within the external die during the withdrawing step solely as a result of interference between the die and the reduced-diameter portion of the tube.

[c9] The process according to claim 1, wherein the forcing step is performed as a single impact between the external die and the end of the tube.

[c10] The process according to claim 1, wherein the forcing step is performed as multiple impacts between the external die and the end of the tube.

[c11] The process according to claim 1, wherein the tube is a heat exchanger tube.

[c12] A process of forming an end of a heat exchanger tube having multiple internal enhancements on an internal circumference of the tube and projecting into an internal passage defined by internal circumference of the tube, the process comprising the steps of:
forcing an external die over the end of the tube and simultaneously inserting a mandrel through the internal passage within the end of the tube, the external die reducing the outer diameter of the end of the tube so as to define a reduced-diameter portion at the end of the tube, the mandrel being positioned farther into the in-

ternal passage than the reduced-diameter portion of the tube throughout the forcing step; and then
while the end of the tube remains within the external die, withdrawing the mandrel from the internal passage and through the reduced-diameter portion of the tube to eliminate the internal enhancements by deformation without physically removing from the tube the material defining the internal enhancements.

[c13] The process according to claim 12, wherein the external die and the mandrel are components of a tool assembly, the tool assembly further comprising a holder having a bore in which the external die is reciprocable in an axial direction of the bore, the mandrel being mounted within the tool assembly so as to be reciprocable relative to the external die.

[c14] The process according to claim 13, wherein the mandrel is attached to the holder so as not to be reciprocable relative to the holder.

[c15] The process according to claim 14, wherein the mandrel is reciprocably received in a bore defined by the external die.

[c16] The process according to claim 15, wherein the end of the tube remains within the external die at the initiation

of the withdrawing step solely as a result of interference between the die and the reduced-diameter portion of the tube, and the mandrel forces the reduced-diameter portion of the tube into greater contact with the die as the mandrel is withdrawn through the reduced-diameter portion of the tube so that the end of the tube remains within the die throughout the withdrawing step.

[c17] The process according to claim 12, wherein the external die comprises a chamfer against which reduction of the end of the tube occurs during the forcing step, and the mandrel is circumscribed by the chamfer during the step of forcing the external die over the end of the tube.

[c18] The process according to claim 12, wherein the mandrel does not interfere with the internal enhancements within the end of the tube during the step of forcing the external die over the end of the tube.

[c19] The process according to claim 12, wherein the forcing step is performed as a single impact between the external die and the end of the tube.

[c20] The process according to claim 12, wherein the forcing step is performed as multiple impacts between the external die and the end of the tube.